Clean Water State Revolving Fund Green Project Reserve
- Preliminary -

Coeur D'Alene WWTP Upgrade Project Phase 5C.2

SRF Loan #WW1601 (FY16) (pop. 46,146)

$20,000,000

Preliminary Green Project Reserve Justification

Categorical GPR Documentation

1. INSTALLS NEW ENERGY-EFFICIENT NEMA PREMIUM MOTORS AND VFDS ON PROCESS PUMPS AND AIR SCOUR BLOWERS (Energy Efficiency). Categorical per GPR 3.2-2: *projects that achieve a 20% reduction in energy consumption.* ($108,700).

Business Case GPR Documentation

2. INSTALLS HIGH SPEED TURBO BLOWERS (Energy Efficiency). Business Case GPR per Section 3.4-1: *project must be cost effective; …must identify energy savings and payback on capital …that does not exceed the useful life of the asset.* ($200,000).

3. INSTALLS TERTIARY FILTRATION TO REDUCE CHEMICAL USE AND UV DISINFECTION ENERGY OUTPUT REQUIREMENTS (Innovative & Energy Efficiency). Business Case GPR per 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment;* also Section 4.5-5b: *Treatment technologies or approaches that significantly…lower the amount of chemicals in the residuals;* Section 3.2-2: … *20% reduction in energy use.* ($5,400,000).

4. INSTALLS ADVANCED FLUORESCENT LIGHTING (Energy Efficiency). Business Case GPR per 3.5-7: *Upgrade of lighting to energy efficient sources such as …compact fluorescent lighting.* ($28,400).

1. New Premium Energy-Efficient Motors and VFDs[1]

Summary

- The majority of new pumps and blowers for this project phase are to be equipped with variable frequency drives (VFDs) and premium efficiency motors to conserve energy and enhance the operability of the treatment process.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 0.5% ($108,700)
- Annual Energy savings = 32% (VFDs); 5% (Motors)

Background

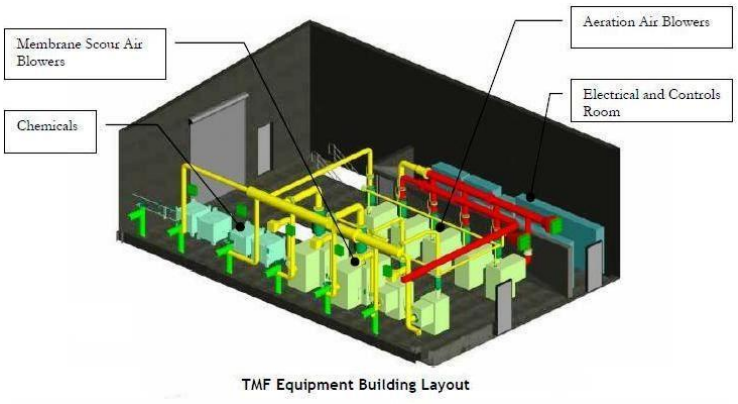
- The City of Coeur d'Alene faces changing effluent discharge conditions in the Spokane River and new regulatory requirements driven by water quality impairment in the Spokane River and downstream Lake Spokane (Long Lake reservoir).
- Premium efficiency motors save on average 3-7% over standard efficiency motors.
- Variable frequency drives greatly add to the efficiency of the process by allowing process equipment to operate at speeds that match the demands rather than operate at full speed all of the time.

Results

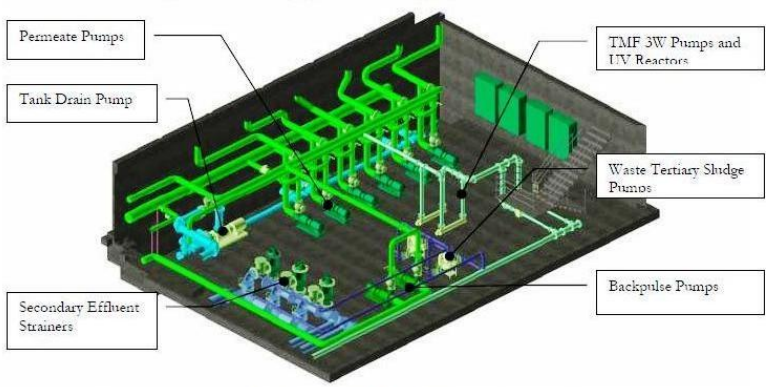
- Equipment that will have premium efficiency motors and/or will be controlled by VFDs is listed in the table below. Equipment controlled by VFDs is noted.

Equipment Name	HP	VFD
Primary Clarifier 3 Mechanism Drive	1.5	Y
Primary Clarifier 3 Scum Pump 1 (Sub.)	7.5	
Primary Clarifier 3 Scum Pump 2 (Sub.)	7.5	
Primary Sludge Pump 4	10	Y
Secondary Clarifier 3Mechanism Drive	1.5	Y
Secondary Scum Pump 2 (Submersible)	7.5	
Secondary Clarifier 3RSS Pump	5	Y
Secondary Clarifier 3WSS Pump	10	
Secondary Effluent Transfer Pump 1 (Sub.)	75	Y
Secondary Effluent Transfer Pump 2 (Sub.)	75	Y
Secondary Effluent Transfer Pump 3 (Sub.)	75	Y
Secondary Effluent Strainer 3	1	
Membrane Tank 3Slide Gate	1	
Membrane Tank 4 Slide Gate	1	

Equipment Name	HP	VFD
Membrane Tank 5 Slide Gate	1	
Permeate Pump 1	40	Y
Permeate Pump 2	40	Y
Permeate Pump 3	40	Y
Permeate Pump 4	40	Y
Permeate Pump 5	40	Y
Backpulse/CIP Pump 1	15	Y
Backpulse/CIP Pump 2	15	Y
Return Tertiary Sludge Pump 3 (sub.)	40	Y
Membrane Scour Air Blower 1	150	Y
Membrane Scour Air Blower 2	150	Y
TMF 3W Pump 1	25	Y
TMF 3W Pump 2	25	Y
Permeate Pump 1	40	Y



TMF Equipment Building Layout



TMF Equipment Building Layout

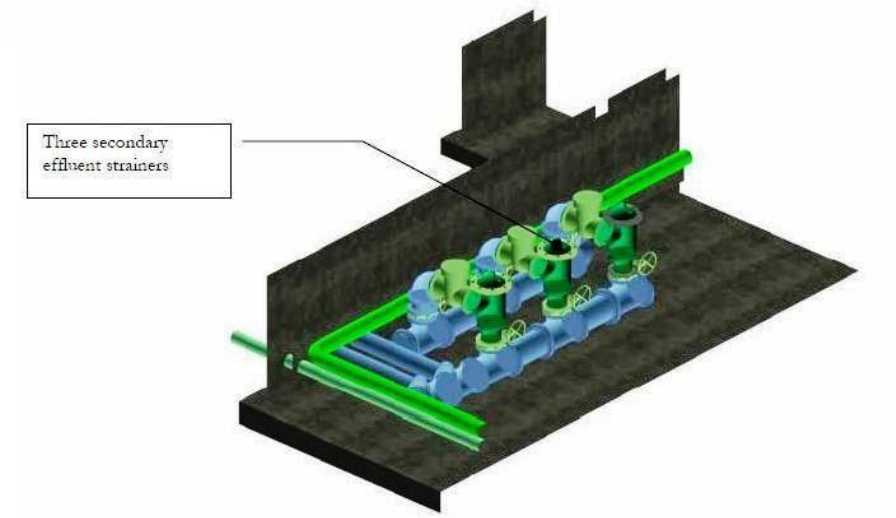
[1] NOTE: Analysis is preliminary and will be completed when project has been awarded and pump & motor schedules are available

NEW PUMPS AND MOTORS (CONT.)

Energy Efficiency Improvements

VFDs

- Equipment without VFDs result in a power usage of 3,959,000 kW-hr per year at an annual power cost of $257,300.
- Equipment controlled by VFDs result in a power usage of 2,696,000 kW-hr per year at an annual power cost of $175,200.
- The use of VFDs results in a power savings of 1,263,000 kW-hr per year and an annual cost savings of $82,100.
- The estimated cost adder for the VFDs is approximately $103,000.



Secondary Effluent Strainers Layout

Motors

- Equipment without premium energy-efficiency motors result in a power usage of 3,959,000 kW-hr per year at an annual power cost of $245,100.
- Equipment powered by premium efficiency motors result in a power usage of 3,770,000 kW-hr per year at an annual power cost of $245,100.
- The use of premium energy-efficiency motors results in a power savings of 189,000 kW-hr per year and an annual cost savings of $12,200.
- The estimated cost adder for the premium efficiency motors is approximately $5,700.

Conclusion

- By using VFDs on the equipment noted in the Table, the City will realize a 32% saving in energy costs.
- The payback on the investment is approximately 1.25 years, substantially less than the useful equipment life of 20 years.
- By providing equipment with premium motors, the City will realize a 5% savings in energy costs.
- The payback on the investment is 0.5 years, substantially less than the useful equipment life of 20 years.
- **GPR Costs**:

Equipment Name	Cost	Payback	Equipment Life
Variable Frequency Drivers	$103,000	1.25 years	20 years
Premium Efficiency Motors	$5,700	6 months	20 years
∴ Total	**$108,700**		

- **GPR Justification:** The VFDs are Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2: *"projects that achieve a 20% reduction in energy consumption."* The Premium Motors are Business Case GPR-eligible per Section 3.2-2: *"If a project achieves less than a 20% reduction in energy efficiency, then it may be justified using a business case."* and per Section 3.4-1: *"… energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset."*

2. HIGH SPEED TURBO BLOWERS

Summary

- Membrane scour air blowers for this project phase will be high-speed turbo blowers.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 1% ($200,000) (Preliminary cost)
- Annual Energy savings = 18%

Background[2]

- See summary in Section 1. Premium Energy Efficient Motors and VFDs.
- The Phase 5C.1 improvements installed four tertiary membrane filtration cassettes; this current phase will install an additional 21 membrane cassettes for a total of 25 membrane cassettes.
- The additional membrane cassettes require a substantial amount of scour air to help free the membrane lumens of sludge. Larger high-speed turbo blowers will replace the existing air scour blowers which are too small to accommodate the increased air demand.

Results

- The horsepower (HP) requirement of the new high-speed turbo blowers is 150 HP for each blower.
- The estimated energy consumed by the proposed system will be 794,000 kW-hr per year at a cost of $52,000.

Energy Efficiency Improvements

- High-speed turbo blowers operate with an increased wire to air efficiency of approximately 73 percent compared to multi-stage centrifugal blowers which operate with a wire to air efficiency of approximately 60 percent.[3]
- This represents a decrease in power consumption of approximately 236,000 kW-hr per year or approximately $15,000.
- The estimated cost for the high-speed turbo blowers is approximately $200,000.

Conclusion

- By using high-speed turbo blowers, the City will reduce the power demand by approximately 18 percent.
- The payback on the investment is 13.3 years which is less than the useful equipment life of at least 20 years.
- **GPR Costs:**

Equipment Name	Cost
High-speed Turbo Blowers	$200,000
∴ FY16 Total = $200,000	

- **GPR Justification:** Business Case GPR-eligible per Section 3.2-2[4]: *"If a project achieves less than a 20% reduction in energy efficiency, then it may be justified using a business case."* and per Section 3.4-1: *"Project must be cost effective."*

[2] 2012 Update to the 2009 Facility Plan, City of Coeur D'Alene, HDR Engineering Inc. February 2012
[3] *City of Coeur d'Alene Advanced Water Reclamation Facility (AWRF) Phase 5 Expansion Preliminary Design Report*, Section 8 - Blower Building, 5/09
[4] Attachment 2. April 2010 EPA Guidance for Determining Project Eligibility.

3. Treatment Process Selection – Tertiary Filtration

Summary

- Tertiary Treatment Phase 2 will provide tertiary filtration capacity up to 5 mgd.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 32% ($5,400,000) (Preliminary cost)
- Annual Energy savings = 20%

Background

- The Phase 5C.1 improvements installed four tertiary membrane filtration cassettes; this current phase will install an additional 21 membrane cassettes for a total of 25 membrane cassettes.
- The tertiary filtration capacity will be up to 5mgd.

Typical Membrane Cassette

Chemical Reduction

- The tertiary membrane filtration (TMF) system was tested in two modes: conventional filtration mode, and recirculation mode.
- When operated in recirculation mode, the chemical sludge generated in the process is retained to maintain a solids inventory. This allows for a longer contact time with the chemical sludge for surface complexation, potentially resulting in greater phosphorus removal.
- When the chemical feed was turned off, the effluent phosphorus did increase over the period without chemical addition; however, the chemical sludge inventory provided a buffer. In conventional filtration mode, the effluent phosphorus increases almost immediately following turning off the chemical feed.

Reduced UV Power Requirements

- These improvements will provide UV disinfection for up to 1mgd of plant utility water.
- Referencing NWRI guidelines[5] and HDR design criteria[6] the minimum allowable UV transmittance (UVT) for media (non-membrane) filtered effluent is 55%. Without filtration, as currently exists, the UVT is likely less than 55%.
- The anticipated minimum UVT with membrane filtration is 65%.
- Communication with a UV vendor suggests that this increase in UVT also allows for the bulb count to be decreased by 15% to 18%.

Results

Chemical Reduction

- The flexibility of the TMF System allows for surface complexation of the alum sludge in recirculation mode, resulting in the use of less chemical since the process utilizes it more efficiently.

Reduced UV Power Requirements

- The minimum required UV dose for reuse applications decreases from 100 mJ/cm^2 to 80 mJ/cm^2 when the UVT increases from 55% to 65% due to membrane filtration .
- The estimated energy consumed by the UV system using a UVT of 55% will be 42,500 kW-hr per year for a cost of approximately $2,800.
- The estimated energy consumed by the UV system using a UVT of 65% will be 34,000 kW-hr per year for a cost of approximately $2,200.

[5] National Water Research Institute (NWRI), Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, 3rd Ed.
[6] HDR Engineering, Inc. UV System Design for Wastewater Treatment and Water Reuse, published May 8, 2008. Fy 16 Narrative II.F.4

TERTIARY FILTRATION (CON'T)

Calculated Energy Efficiency Improvements

- Tertiary filtration reduces the power consumption required by increasing the UV transmittance of the filtered effluent. The reduction is equal to the reduction in required doses and is approximately 20%.
- This represents a decrease in power consumption of approximately 8,500 kW-hr per year or approximately $550.

Conclusion

- The flexibility of operation of the Tertiary Membrane Filtration System can result in reduced chemical use for phosphorus removal, also resulting in less chemical residuals.[7]
- By using tertiary membrane filtration, the City will reduce the power demand required for UV disinfection by approximately 20%.
- **GPR Costs**: Tertiary filter = $5,400,000
- **GPR Justification**: Innovative Business Case GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment;* also Section 4.5-5b: *Treatment technologies or approaches that significantly…lower the amount of chemicals in the residuals;* also Categorically GPR-eligible per Section 3.2-2[8]: *results in…20% reduction in energy use*.

[7] The exact amount of chemical reduction will be tested during the one-year operation of the Phase 1 (5C) improvements.
[8] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. Page 9.

4. Advanced Fluorescent Lighting

Summary

- Energy efficiency from the installation of advanced fluorescent lighting in all indoor spaces, high efficiency discharge lighting-high efficiency LED lighting for use in outdoor areas with lighting controls.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = ($28,400)

Energy Efficiency Improvements

- Energy efficient T-8 magnetic fluorescent lighting is approximately 28 percent more energy efficient than standard T-12 magnetic fluorescent lighting for relatively the same light output. [9]
- LED lighting is approximately 58 percent more energy efficient that typical high pressure sodium lighting for relatively the same light output.[10]
- Outdoor lighting will be controlled with photocells. The instant ON capability of LED allow for motion sensing which provides potential for greater control over on-OFF cycles.

Conclusion

- **GPR Costs**:

Equipment Name	Cost
Fluorescent Lighting	$13,100
LED Lighting	$12,300
Lighting Controls	3,000
Estimated Total	**$28,400**

- **GPR Justification**: Advanced fluorescent lighting is GPR-eligible by a Business Case per 3.5-7[11]: *Upgrade of POTW lighting to energy efficient sources such as …compact fluorescent.*

[9] National Lighting Product Information Program, *Lighting Answers*, Volume 1 Issue 1, April 1993.
[10] Global Green Energy, *ROI Analysis - 250W high pressure sodium vs. EcoBright 120W LED street light*, accessed via http://www.gg-energy.com/
[11] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. Page 10.